

YAMAGUCHI ET AL. -- 10/624,669
Client/Matter: 008312-0305111

IN THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Original) An image processing method of creating composite image information by embedding sub-information in main image information, comprising:

performing, for the main image information, first pre-processing corresponding to pixel formation processing for image recording;

performing second pre-processing as geometric transformation processing for the main image information having undergone the first pre-processing;

performing embedding processing of creating composite image information by embedding sub-information in the main image information; and

performing transformation processing inverse to the transformation processing in the second pre-processing for the composite image information created by the embedding processing.

2. (Original) An image processing method of recording, on a recording medium in a visible state, composite image information created by embedding sub-information in visible main image information in an invisible state, comprising:

performing, for the main image information, first pre-processing corresponding to pixel formation processing for image recording;

performing second pre-processing as geometric transformation processing for the main image information having undergone the first pre-processing;

performing embedding processing of creating composite image information by embedding sub-information in the main image information having undergone the second pre-processing in an invisible state;

performing transformation processing inverse to the transformation processing in the second pre-processing for the composite image information created by the embedding processing; and

YAMAGUCHI ET AL. -- 10/624,669
Client/Matter: 008312-0305111

recording, on a recording medium, the composite image information, inversely transformed by the inverse transformation processing, by performing an alternate driving/recording scheme of alternately recording even-numbered and odd-numbered pixels in a main scanning direction of a recording device on a recording line basis.

3. (Original) A method according to claim 2, wherein in the embedding processing, sub-information is embedded in main image information in an invisible state by performing color difference modulation processing using a preset, predetermined color difference amount.

4. (Original) A method according to claim 2, wherein in the embedding processing, the preset color difference amount is corrected in accordance with each pixel information of the main image information on a pixel basis, and sub-information is embedded in the main image information in an invisible state by performing color difference modulation processing by using the corrected color difference amount.

5. (Original) A method according to claim 2, wherein in the embedding processing, a processing of compressing a distribution of pixel luminance values of the main image information into a predetermined range is performed before embedding of the sub-information.

6. (Original) A method according to claim 5, wherein the processing of compressing the distribution of the pixel luminance values of the main image information comprises processing of omitting values not less than an upper limit value of a color plane of each pixel and not more than a lower limit value thereof.

7. (Original) A method according to claim 5, wherein the processing of compressing the distribution of the pixel luminance values of the main image information comprises processing of omitting values not less than an upper limit value of a color plane of each pixel

YAMAGUCHI ET AL. -- 10/624,669
Client/Matter: 008312-0305111

and not more than a lower limit value thereof, and processing of correcting a tone curve after the omitting processing into a straight line.

8. (Original) A method according to claim 2, wherein in the embedding processing, a distribution of pixel luminance values of the main image information before embedding of the sub-information into a predetermined range, the sub-information is embedded in the main image information having undergone the compression processing, and processing inverse to the compression processing is performed.

9. (Original) A method according to claim 2, wherein in the embedding processing, color difference modulation processing is performed by using the main image information, the sub-information, and key information used to restore the sub-information, thereby creating composite image information.

10. (Original) A method according to claim 9, in which
the key information is constituted by a geometric pattern having a predetermined specific frequency component, and
which further comprises
optically reading the composite image information from a recording object on which the composite image information is recorded, and
restoring the sub-information from the composite image information by performing filter processing for the optically read composite image information using a frequency filter using a specific frequency component of the key information.

11. (Original) A method according to claim 9, wherein
the key information is constituted by a geometric pattern having a predetermined specific frequency component, and

YAMAGUCHI ET AL. - 10/624,669
Client/Matter: 008312-0305111

in the first pre-processing, after processing of removing a frequency component identical to the specific frequency component of the key information from the main image information or weakening the frequency component, processing corresponding to the pixel forming processing at the time of image recording is performed for the main image information.

12. (Original) A method according to claim 9, wherein

the key information is constituted by a geometric pattern having a predetermined specific frequency component and includes a plurality of pieces of key information, and

in the embedding processing, frequency component analysis of the main image information is performed, and composite image information is created by selecting key information corresponding to one of said plurality of pieces of key information which has a frequency component having the lowest similarity to the frequency component of the main image information.

13. (Original) An image processing method of recording, on a recording medium in a visible state, composite image information created by embedding sub-information in visible main image information in an invisible state, comprising:

performing first pre-processing of thinning out main image information in correspondence with pixel formation processing at the time of image recording;

performing second pre-processing including geometric transformation processing of, after rotating the main image information through a predetermined angle, removing a thinned-out portion from the main image information, compressing an effective portion of the main image information, and reconstructing the main image information;

performing embedding processing of embedding the sub-information in the main image information having undergone the second pre-processing in an invisible state by performing color difference modulation processing using the main image information, the

YAMAGUCHI ET AL. — 10/624,669
Client/Matter: 008312-0305111

sub-information, and key information used to restore the sub-information, thereby creating composite image information;

performing inverse transformation processing of performing transformation processing inverse to transformation processing in the second pre-processing for the composite image information after expanding and reconstructing an effective portion of the composite image information by inserting, in the composite image information, not-to-be-recorded information corresponding to the thinned-out portion of the main image information; and

performing recording processing of recording, on a recording medium, the composite image information, inversely transformed by the inverse transformation processing, by performing an alternate driving/recording scheme of alternately recording even-numbered and odd-numbered pixels in a main scanning direction of a recording device on a recording line basis.

14. (Original) A method according to claim 13, wherein in the first pre-processing, when the main image information is to be thinned out, even-numbered and odd-numbered pixels are alternately thinned out in correspondence with a recording line of a recording device.

15. (Original) An image processing method of recording, on a recording medium in a visible state, composite image information created by embedding sub-information in visible main image information in an invisible state, comprising:

performing first pre-processing of thinning out main image information in correspondence with pixel formation processing at the time of image recording;

performing second pre-processing including geometric transformation processing of, after rotating the main image information through a predetermined angle, removing a thinned-out portion from the main image information, compressing an effective portion of the main image information, and reconstructing the main image information;

YAMAGUCHI ET AL. - 10/624,669
Client/Matter: 008312-0305111

performing embedding processing of embedding the sub-information in the main image information in an invisible state by superimposing the main image information and superimposition information created by performing color difference modulation processing using the sub-information and key information used to restore the sub-information, thereby creating composite image information;

performing inverse transformation processing of performing transformation processing inverse to transformation processing in the second pre-processing for the composite image information after expanding and reconstructing an effective portion of the composite image information by inserting, in the composite image information, not-to-be-recorded information corresponding to the thinned-out portion of the main image information; and

performing recording processing of recording, on a recording medium, the composite image information, inversely transformed by the inverse transformation processing, by performing an alternate driving/ recording scheme of alternately recording even-numbered and odd-numbered pixels in a main scanning direction of a recording device on a recording line basis.

16-30. (Canceled)

31. (New) An image recording apparatus comprising:

a first pre-processing section which thins out main image information in correspondence with pixel formation processing in the image recording apparatus;

a second pre-processing section which performs second pre-processing including geometric transformation processing of, after rotating the main image information through a predetermined angle, removing a thinned-out portion from the main image information, compressing an effective portion of the main image information, and reconstructing the main image information;

YAMAGUCHI ET AL. - 10/624,669
Client/Matter: 008312-0305111

an embedding processing section which embeds the sub-information in the main image information in an invisible state by performing color difference modulation processing, thereby creating composite image information;

an inverse transformation processing which performs inverse transformation processing of performing transformation processing inverse to transformation processing in the second pre-processing for the composite image information after expanding and reconstructing an effective portion of the composite image information by inserting, in the composite image information, not-to-be-recorded information corresponding to the thinned-out portion of the main image information; and

a recording section which performs recording processing of recording, on a recording medium, the composite image information, inversely transformed by the inverse transformation processing section, by performing an alternate driving/recording scheme of alternately recording even-numbered and odd-numbered pixels in a main scanning direction of a recording device on a recording line basis.